II. AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in this Application:

Listing of Claims:

1. (Currently Amended) Method for controlling a direct injection internal combustion engine selectively operative in one of a homogeneous charge combustion mode and a stratified charge combustion mode and having an exhaust gas conduit fluidly connected to a NOx trap generally effective to accumulate NOx emissions during lean operation of the engine and to release said accumulated NOx emissions during rich operation of the engine comprising:

defining a first engine operating region as the only region in which stratified charge combustion mode is enabled;

defining a second operating region consisting of a reduced portion of the first operating region, the second operating region operative to redefine the only area in which stratified charge combustion mode is enabled;

monitoring engine operation;

determining a cumulative mass of NOx stored on the NOx trap device;

operating the engine in the stratified charge combustion mode only when the engine operation is within the first operating region and the cumulative mass of NOx stored on the NOx trap device is less than a first threshold; and

operating the engine in a stratified charge combustion mode when the engine operation is within the second operating region and the cumulative mass of the NOx stored on the NOx trap device is greater than the first threshold.

2.-9. (Canceled)

10. (Previously Presented) Method for controlling regeneration of a NOx trap comprising:

estimating an accumulated NOx in a NOx trap located in the exhaust path of an engine; and,

hastening regeneration of the NOx trap by reducing the size of a stratified charge operating region of the engine when the accumulated NOx exceeds a first threshold value and initiating regeneration when the stratified charge operating region of the engine is exited;

wherein reducing the stratified charge operating region comprises reducing engine speed and engine load at which to operate the engine in stratified charge operating mode.

11. (Original) The method of claim 10, further comprising:

estimating the temperature of the NOx trap; and,

determining a desired air-fuel ratio for initiating regeneration of the NOx trap, the desired air-fuel ratio being determined based upon one or a combination of the estimated accumulated NOx stored within the NOx trap and the temperature of the NOx trap.

12. (Canceled)

13. (Original) The method of claim 10, further comprising:

ending regeneration and resetting the accumulated NOx to the level of the remaining stored NOx in the NOx trap when a regeneration ending event is reached.

14. (Original) The method of claim 13, further comprising:

monitoring exhaust gases flowing out of the NOx trap wherein the regeneration ending event is reached when the monitored exhaust gases flowing out of the NOx trap show a rich deviation.

15. (Original) The method of claim 13, further comprising:

monitoring the elapsed regeneration event time wherein the regeneration ending event is reached when the elapsed regeneration event time exceeds a target maximum regeneration event time interval.

16. (Original) The method of claim 13, further comprising:

monitoring driver torque demand on the engine wherein the regeneration ending event is reached when the driver torque demand drops below a threshold value.

17. (Original) The method of claim 13, wherein the regeneration ending event is triggered by a driver initiated action.

18. (Previously Presented) Article of manufacture comprising:

a storage medium having a computer program encoded therein for causing an engine controller to control a direct injection internal combustion engine selectively operative in one of a homogeneous charge combustion mode and a stratified charge combustion mode and having an exhaust gas conduit fluidly connected to a NOx trap device said program including:

code to define a first engine speed/load operating region;

code to define a second engine speed/load operating region consisting of a reduced portion of the first operating region;

code to monitor engine operation;

code to monitor temperature of the NOx trap;

code to determine a cumulative mass of NOx stored on the NOx trap device;

code to operate the engine in the stratified charge combustion mode only when the engine operation is within the first operating region and the cumulative mass of NOx stored on the NOx trap device is less than a first threshold;

code to operate the engine in the stratified charge combustion mode when the engine operation is within the second operating region and the cumulative mass of NOx stored on the NOx trap device is greater than the first threshold;

code to control the engine-out air/fuel ratio to regenerate the NOx trap when the temperature exceeds a predetermined temperature threshold; and,

code to control the engine in the homogeneous charge combustion mode and control the engine-out air/fuel ratio to regenerate the NO_X trap when the determined cumulative mass of NO_X stored on the NO_X trap device exceeds a second threshold, said second threshold greater than the first threshold.

19.-26. (Canceled)

27. (Previously Presented) The method of claim 1, wherein the first and second engine operating regions comprise engine operating regions defined in terms of an engine speed range and an engine load range.

28. (Previously Presented) The method of claim 27, wherein defining the second operating region consisting of the reduced portion of the first operating region comprises reducing the engine speed range of the first operating region.

29. (Previously Presented) The method of claim 27, wherein defining the second operating region consisting of the reduced portion of the first operating region comprises reducing the engine speed range and the engine load range of the first operating region.

30. (Previously Presented) The method of claim 1, further comprising operating the direct-injection internal combustion engine selectively operative in the homogeneous charge combustion mode when the engine operation is outside the first operating region when the cumulative mass of NOx stored on the NOx trap device is greater than the threshold.

31. (Previously Presented) The method of claim 30, further comprising regenerating the NOx trap by controlling the engine-out air/fuel ratio to an air/fuel ratio rich of stoichiometry.

32. (Previously Presented) The method of claim 31, comprising monitoring exhaust gas output from the NOx trap, and, ending the regenerating of the NO_X trap when the monitored exhaust gas indicates a rich deviation of gases flowing out of the NOx trap.

33. (Previously Presented) The method of claim 31, comprising ending the regenerating of the NOx trap upon expiration of a regeneration timer.

34. (Previously Presented) The method of claim 31, comprising ending the regenerating of the NOx trap when the engine operation falls below a threshold value for the engine operating region.

35. (Previously Presented) The method of claim 1, further comprising:

monitoring temperature of the NOx trap; and,

controlling the engine-out air/fuel ratio to regenerate the NO_X trap when the temperature exceeds a predetermined temperature threshold.

36. (Previously Presented) The method of claim 1, further comprising operating the engine in the homogeneous charge combustion mode and controlling the engine-out air/fuel ratio to regenerate the NO_X trap when the determined cumulative mass of NO_X stored on the NO_X trap device exceeds a second threshold, said second threshold greater than the first threshold.

37. (New) The method of claim 1, further comprising defining an area of low engine speed and engine load, wherein stratified charge combustion mode is highly preferred, and further defining said second operating region as comprising an area greater than said area of low engine speed and engine load.

38. (New) The method of claim 37, comprising iteratively defining said second operating region, each iterative definition reducing said second operating region to a smaller area than the previous second operating region.

39. (New) Method for controlling regeneration of a NOx trap comprising:

estimating an accumulated NOx in a NOx trap located in the exhaust path of an engine;

estimating a temperature of the NOx trap;

determining whether the temperature of the NOx trap exceeds a threshold temperature;

determining whether the estimated NOx in the NOx trap exceeds a second threshold value greater than a first threshold value, the second predetermined threshold comprising a fraction of capacity of the NOx trap;

determining a desired air-fuel ratio for initiating regeneration of the NOx trap, the desired air-fuel ratio being determined based upon one or a combination of the estimated NOx stored within the NOx trap and the temperature of the NOx trap; initiating regeneration of the NOx trap when the estimated NOx in the NOx trap exceeds the second threshold value or when the estimated temperature of the NOx trap exceeds the threshold temperature by forcing homogenous operation of the engine at the desired air-fuel ratio;

hastening regeneration of the NOx trap by reducing the size of a stratified charge operating region of the engine when the estimated NOx in the NOx trap exceeds the first threshold value and initiating regeneration when the stratified charge operating region of the engine is exited; and

wherein reducing the stratified charge operating region comprises reducing engine speed and engine load at which to operate the engine in stratified charge operating mode.